

The Korean Social Life, Health and Aging Project-Health Examination Cohort

Ju-Mi Lee¹, Won Joon Lee¹, Hyeon Chang Kim^{1,2}, Wungrak Choi³, Jina Lee⁴, Kiho Sung⁴, Sang Hui Chu⁵, Yeong-Ran Park⁶, Yoosik Youm⁴

¹Department of Preventive Medicine, Yonsei University College of Medicine, Seoul; ²Cardiovascular and Metabolic Diseases Etiology Research Center, Yonsei University College of Medicine, Seoul; ³Institute of Vision Research, Department of Ophthalmology, Yonsei University College of Medicine, Seoul; ⁴Department of Sociology, Yonsei University College of Social Sciences, Seoul; ⁵Department of Clinical Nursing Science, Yonsei University College of Nursing, Seoul; ⁶Division of Silver Industry, Kangnam University, Yongin, Korea

The Korean Social Life, Health, and Aging Project (KSHAP) is a population-based longitudinal study of health determinants among elderly Koreans. The target population of the KSHAP are people aged 60 years or older and their spouses living in a rural community of Korea. A complete enumeration survey was conducted in the first wave of the KSHAP on 94.7% (814 of 860) of the target population between December 2011 and July 2012. The KSHAP-Health Examination (KSHAP-HE) cohort consists of 698 people who completed additional health examinations at a public health center (n=533) or at their home (n=165). Face-to-face questionnaires were used to interview participants on their demographics, social network characteristics, medical history, health behaviors, cognitive function, and depression symptoms. Health center examinations included anthropometric measures, body impedance analysis, resting blood pressure measurement, radial artery tonometry, bone densitometry, the timed up-and-go test, and fasting blood analysis. However, only anthropometric measures, blood pressure measurement, and non-fasting blood analysis were available for home health examinations. Collaboration is encouraged and access to the KSHAP baseline data will be available via the website of the Korean Social Science Data Archive (<http://www.kossda.or.kr>).

KEY WORDS: Cohort studies, Social determinants of health, Aged, Rural population, Korea

INTRODUCTION

The Korean Social Life, Health, and Aging Project (KSHAP) began by benchmarking from the US National Social Life, Health, and Aging Project (NSHAP). The NSHAP interviewed 3,005 community-dwelling adults aged 57 to 85 years across the US [1]. The NSHAP collected ego-centric social network data with a module that allows each respondent to identify the socio-de-

mographic information of their network members and the relationships among them [2]. Using the NSHAP data, researchers have found that some types of social networks were associated with various health-related dimensions such as subjective well-being [3], depressive symptoms [4], hypertension [5], health-related behaviors [6], health-care utilization [7], and others.

The KSHAP is a longitudinal population-based study aiming to understand the current status, trends, and determinants of health among older, community-dwelling Koreans. Detailed information on the KSHAP study design will be published elsewhere. Briefly, the purpose of the KSHAP is to examine physical health, emotional health, cognitive function, health behaviors, medical service use, social connectedness, and relationship quality as well as assess any interactions within these variables and collect follow-up data. The KSHAP-Health Examination (KSHAP-HE) cohort additionally aims to measure anthropometric variables, blood biomarkers, blood pressure, mobility function, and bone density to assess determinants of cardiovas-

Correspondence: Hyeon Chang Kim

Department of Preventive Medicine, Yonsei University College of Medicine,
50-1 Yonsei-ro, Seodaemun-gu, Seoul 120-752, Korea
Tel: +82-2-2228-1873, Fax: +82-2-392-8133, E-mail: hckim@yuhs.ac

Received: Mar 28, 2014, Accepted: Apr 18, 2014, Published: May 13, 2014

This article is available from: <http://e-epih.org/>

© 2014, Korean Society of Epidemiology

© This is an open-access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

cular and metabolic health among elderly Koreans. The KSHAP-HE study was designed using a multi-disciplinary approach including a social network analysis, questionnaire interview, physical examination, functional assessment, and biomarker analysis to comprehensively understand social, emotional, and physical health.

STUDY PARTICIPANTS

The KSHAP aimed to recruit the entire population (not a sample) of adults aged 60 years or older and their spouses living in within one township in Gangwha Island, Korea. This township is a typical, rural, Korean village where farming is the main industry. As of January 2013, the total population was estimated as 1,864 people and 871 families. With the aid of township officers and after performing a pilot study, a total of 860 people were identified as the target population of KSHAP. Of these 860 adults, face-to-face interviews were performed on 814 people from December 2011 to March 2012 (94% response rate). All KSHAP participants were also invited to participate in a health examination at the local public health center, and 533 adults (65.5%) completed the examination. An additional 165 people (20.3%) participated in home health examinations from March through July 2012. In total, data on 698 people (85.7% of KSHAP participants; 81.1% of target population) who completed health examinations were collected for the KSHAP-HE cohort.

ETHICAL CONSIDERATIONS

The institutional review board (IRB) of Yonsei University approved this study (YUIRB-2011-012-01). All participants were informed of their right to withdraw from the study at any point with no penalty, and informed consent was provided. All scientific data were formulated as anonymous and encrypted. The anonymous baseline dataset was registered with the Korean Social Science Data Archive.

MEASUREMENTS

The KSHAP-HE cohort plans to collect follow-up health examination data between 2015 and 2017. Follow-up examinations will repeat the baseline measurements to observe any 5-year changes to physical health, emotional health, cognitive function, health behaviors, and social network characteristics. In addition to the active follow-up plan, information on newly-diagnosed diseases and deaths will be collected from self-re-

ported and family-reported data as well as through the National Health Insurance claims database and National Mortality Database.

QUESTIONNAIRE INTERVIEWS

The interviews were conducted at the public health center or respondents' homes for an average of 48 minutes. Participants were interviewed by trained personnel using standardized questionnaires according to the pre-determined protocol. In addition, the entire interview process was continuously monitored by the designated field director.

Participants were asked about their socio-demographic factors, medical history, and health behaviors. Socio-demographic measures included education, occupation, marriage, household income, religion, the social relationship within their family and community, and social support received from others. Medical history included hypertension and hypertension management, diabetes and diabetes management, dyslipidemia and dyslipidemia management, metabolic syndrome, osteoporosis, fractures, incidents of falls, cancer, stroke, heart diseases, arthritis, lung diseases, eye disease, hepatitis, depression, urinary incontinence, and prostate enlargement. Health behaviors included cigarette smoking, alcohol drinking, sleep duration, and frequency of receiving vaccination and health screenings. Depression symptoms were assessed by the Center for Epidemiologic Studies-Depression Scale [8]. In addition, questions about stress level, overall life satisfaction, thoughts of suicide, and suicide attempts were asked. Cognitive function was assessed using the Korean version of Mini Mental State Examination for Dementia Screening [9-11]. Overall health status was assessed using the 12-item Short Form Health Survey, which was validated in a previous study [12] and translated for use in Korea [13,14].

Social network characteristics were assessed using the Korean version of the social network survey, which is an identical questionnaire to the NSHAP from the US. Prior to the social network survey, we constructed a comprehensive list of the target population with the aid of the community office and a pilot study. With the complete social network, we were able to perform a global network analysis. A detailed description of the methods and results of the social network analysis will be published elsewhere. Typically, psychological measures are the main focus of validation when translating questionnaires; however, questionnaires that collect data on social network measures have been applied across various societies since they are supposed to measure actual behaviors not attitudes or beliefs. Since Burt proposed a name generator to measure social networks to be used in the General Social Survey in the US [15], a similar but less elaborate version of this kind of social network ques-

tionnaire has been used in the Korean General Social Survey since 2003.

HEALTH EXAMINATIONS

At the public health center, collected measurements included body composition, resting blood pressure, radial pulse wave analysis, bone densitometry, the timed up-and-go (TUG) test, and fasting blood analysis. Standing height was measured to the nearest 0.1 cm using a stadiometer and body weight was measured to the nearest 0.1 kg on a digital scale. Body mass index (BMI) was calculated as body weight in kilograms divided by height in meters squared. Body composition data collected body fat mass, percent body fat, lean mass, fat free mass, skeletal muscle mass, and appendicular fat free mass, which were all estimated using the bioelectric impedance analyzer (InBody 370; Biospace Co. Ltd., Seoul, Korea). Resting systolic and diastolic blood pressure, mean arterial pressure, and pulse rate were measured twice with the oscilloscopic method using an automatic sphygmomanometer (CareScape V100; GE Healthcare Medical Systems Information Technologies Inc., Milwaukee, WI, USA). Prior to each measurement, all participants rested for at least five minutes in a seated position, and the cuff was adapted to the circumference of their right upper arm. If the first and second measurements differed by ≥ 10 mmHg, either for systolic or diastolic pressure, the additional blood pressure measurements were performed, and the average of the last two measurements was used to determine the blood pressure level. In addition, the radial augmentation index and central blood pressure measurements were estimated using an automated radial pulse waveform analyzer (HEM-9000AI; Omron Healthcare, Kyoto, Japan). Mobility function was assessed by a TUG test. This test measures the amount of time, to the nearest second, taken to rise from a chair, walk 3 meters to the end of a pre-arranged line, and then return to the chair and sit down. Blood samples were collected from the antecubital vein after at least an 8 hour fast. Collected blood samples were analyzed at a central research laboratory for complete blood count, glucose, insulin, total cholesterol, high-density lipoprotein cholesterol, triglycerides, protein, albumin, aspartate aminotransferase, alanine aminotransferase, urea nitrogen, creatinine, and C-reactive protein. Baseline assessments performed in the KSHAP-HE cohort are summarized in Table 1.

BASELINE CHARACTERISTICS OF THE COHORT

Table 2 summarizes the baseline characteristics acquired from questionnaire interviews. The mean age was 72.4 years for the

Table 1. Summary of the baseline data collection of the Korean Social Life, Health and Aging Project-Health Examination Cohort

Categories	Measurements
Socio-demographic data	Household membership Household income Education Current and past occupation Social position in the community Marital status Social support from spouse Social support from family members and relatives Social support from friends and neighbors Intergenerational support Social activity involvement Welfare service usage
Social network analysis	Complete network analysis Ego-centric network analysis
Health behaviors	Cigarette smoking Alcohol consumption Sleep duration Health screening Influenza vaccination
Physical health	Self-rated general health (Korean version of SF-12) Physician diagnosed diseases Falls
Mental health and cognitive function	Self-rated emotional stress Suicidal thoughts and/or attempts Center for Epidemiologic Studies-Depression Scale Life satisfaction Mini Mental State Examination for Dementia Screening
Physical examination and performance	Standing height and body weight Waist, hip, and thigh circumference Resting brachial blood pressure Bio-impedance analysis for body composition study ¹ Radial pulse wave analysis for augmentation index and central blood pressure ¹ Ultrasound calcaneus bone densitometry ¹ Timed-up-and-go test ¹
Blood assays	Serum storage Blood cell counts, hemoglobin, hematocrit, MCV, MCH, and MCHC Serum protein, albumin, and total bilirubin Aspartate and alanine aminotransferase levels Blood urea nitrogen and creatinine Glucose, insulin Total cholesterol, high-density lipoprotein-cholesterol, and triglycerides C-reactive protein

MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration.

¹Not available for home health examinations.

total population (n=698), 72.9 years among males (n=286), and 72.1 years among females (n=412). Male participants had higher levels of education and were more likely to smoke cigarettes and drink alcohol than were female participants. However, diagnoses of hypertension and osteoporosis were more frequent among females than males. The results of the health examinations at each site are shown in Tables 3 and 4.

Table 2. Socio-demographics, health behaviors, and known diseases of the cohort members

Variables	Total (n = 698)	Men (n = 286)	Women (n = 412)	p for gender comparison
Age (yr)				
Continuous	72.4 ± 7.9	72.9 ± 7.1	72.1 ± 8.4	0.174
≤ 59	32 (4.6)	3 (1.1)	29 (7.0)	0.002
60-69	206 (29.5)	85 (29.7)	121 (29.4)	
70-79	346 (49.6)	155 (54.2)	191 (46.4)	
80-89	97 (13.9)	39 (13.6)	58 (14.1)	
≥ 90	17 (2.4)	4 (1.4)	13 (3.2)	
Education (yr)				
Never	214 (30.7)	53 (18.5)	161 (39.1)	< 0.001
≤ 6	199 (28.5)	100 (35.0)	99 (24.0)	
7-9	64 (9.2)	29 (10.1)	35 (8.5)	
10-12	168 (24.1)	78 (27.3)	90 (21.8)	
≥ 13	53 (7.6)	26 (9.1)	27 (6.6)	
Marriage				
Currently married	520 (74.5)	262 (91.6)	258 (62.6)	< 0.001
Divorced, widowed	173 (24.8)	20 (7.0)	153 (37.1)	
Unmarried	5 (0.7)	4 (1.4)	1 (0.2)	
Employment				
Employed	412 (59.0)	203 (71.0)	209 (50.7)	< 0.001
Self-employed	9 (1.3)	4 (1.4)	5 (1.2)	
Unemployed	277 (39.7)	79 (27.6)	198 (48.1)	
Social network characteristics ¹				
In-degree centrality	1.98 ± 1.60	2.15 ± 1.65	1.86 ± 1.55	0.019
Out-degree centrality	2.25 ± 1.32	2.47 ± 1.39	2.10 ± 1.24	< 0.001
Communication density	0.98 ± 0.11	0.99 ± 0.06	0.97 ± 0.13	0.049
Friendship density	0.88 ± 0.27	0.89 ± 0.23	0.87 ± 0.29	0.215
Cigarette smoking				
Non-smoker	494 (70.8)	90 (31.5)	404 (98.1)	< 0.001
Ex-smoker	120 (17.2)	120 (42.0)	0 (0.0)	
Current smoker	84 (12.0)	76 (26.6)	8 (1.9)	
Alcoholic consumption				
Non-drinker	465 (66.6)	122 (42.7)	343 (83.3)	< 0.001
Drinker (< 1/wk)	86 (12.3)	43 (15.0)	43 (10.4)	
Drinker (≥ 1/wk)	147 (21.1)	121 (42.3)	26 (6.3)	
Physician-diagnosed diseases				
Hypertension	359 (51.4)	130 (45.5)	229 (55.6)	0.009
Diabetes mellitus	130 (18.6)	60 (21.0)	70 (17.0)	0.183
Dyslipidemia	68 (9.8)	25 (8.7)	43 (10.5)	0.445
Osteoporosis/osteopenia	164 (23.5)	20 (7.0)	144 (35.0)	< 0.001
Cancer	30 (4.3)	17 (5.9)	13 (3.2)	0.074

Data are presented as mean ± standard deviation or number (%).

¹Social network characteristics were available for 643 people (270 males and 373 females). In-degree centrality indicates the number of people who chose the respondent as their social partner; Out-degree centrality indicates the number of people the respondent indicated as social partners; Communication density indicates the proportion of all possible pairs of social ties those who reported ever talking to each other; Friendship density indicates the proportion of all possible pairs of social ties those who reported feeling close to each one another.

As of March 2014, two articles have been published in peer-reviewed journals analyzing baseline KSHAP-HE cohort data. A cross-sectional analysis of 657 KSHAP-HE participants (aged 60 years or older) indicated that social network characteristics differed according to BMI among males (n=273) and females (n=384). After adjusting for potential confounders, a larger but coarse social network size was significantly associated with a higher BMI among men (p=0.037), while a lower communication frequency was associated with a higher BMI among women (p=0.049). However, network density and size were not associated with BMI among women, and communication frequen-

cy was not associated with BMI among men [16]. These findings suggest that social network structure (network size and density) and activation (communication or meeting frequency) may affect physical health among men and women differently. We also are planning to analyze gender differences in the association between social network characteristics and emotional health in a future study.

Another cross-sectional study analyzed only participants who had completed health examinations at the public health center and observed an independent association between decreased muscle mass and increased arterial wall stiffness [17]. Appen-

Table 3. Site-specific results of the physical examinations

Variables	Public health center examinations			Home examinations		
	Total (n = 533)	Men (n = 212)	Women (n = 321)	Total (n = 165)	Men (n = 74)	Women (n = 91)
Age (yr)	72.5 ± 7.5	73.0 ± 6.7	72.1 ± 8.0	72.2 ± 9.1	72.6 ± 8.2	71.9 ± 9.8
Weight (kg)	58.1 ± 10.5 (n = 531)	62.6 ± 10.3	55.1 ± 9.5 (n = 319)	57.3 ± 10.7 (n = 155)	61.9 ± 10.3 (n = 71)	53.5 ± 9.6 (n = 84)
Height (cm)	155.2 ± 9.0 (n = 531)	163.1 ± 6.0	150.0 ± 6.4 (n = 319)	154.4 ± 10.1 (n = 155)	161.8 ± 6.7 (n = 70)	148.3 ± 8.2 (n = 84)
Body mass index (kg/m ²)	24.0 ± 3.4 (n = 531)	23.5 ± 3.3	24.3 ± 3.4 (n = 319)	23.9 ± 3.4 (n = 150)	23.7 ± 3.2 (n = 68)	24.0 ± 3.6 (n = 82)
Percent body fat (%)	33.5 ± 8.4 (n = 518)	28.7 ± 8.3 (n = 209)	36.8 ± 6.8 (n = 309)			
Systolic BP (mmHg)	132.9 ± 19.6	131.6 ± 19.1	133.7 ± 20.0	138.3 ± 21.2	136.0 ± 21.1	140.1 ± 21.3
Diastolic BP (mmHg)	71.4 ± 9.9	73.0 ± 10.2	70.3 ± 9.6	74.2 ± 10.4	73.1 ± 10.4	75.1 ± 10.4
Pulse rate (/min)	69.1 ± 11.25	68.6 ± 11.8	69.4 ± 10.9			
Augmentation index (%)	91.5 ± 12.2 (n = 522)	86.9 ± 12.8 (n = 208)	94.6 ± 10.8 (n = 314)			
T-score at calcaneus bone	-2.07 ± 1.47 (n = 525)	-1.57 ± 1.28 (n = 211)	-2.41 ± 1.50 (n = 313)			
Timed up-and-go test						
< 14 s	342 (64.7)	148 (69.8)	194 (61.2)			
≥ 14 s	187 (35.4)	64 (30.2)	123 (38.8)			

Data are presented as mean ± standard deviation or number (%).
BP, blood pressure.

Table 4. Site-specific blood assay results

Variables	Public health center examinations			Home examinations		
	Total (n = 524)	Men (n = 209)	Women (n = 315)	Total (n = 165)	Men (n = 72)	Women (n = 91)
Hemoglobin (g/dL)	13.6 ± 1.3 (n = 522)	14.4 ± 1.2	13.1 ± 1.0 (n = 313)	12.7 ± 1.5	13.5 ± 1.3	12.0 ± 1.3
Hematocrit (%)	42.4 ± 3.9 (n = 522)	44.7 ± 3.7	40.8 ± 3.2 (n = 313)	40.0 ± 4.6	42.5 ± 4.0	38.0 ± 4.1
Protein (g/dL)	7.39 ± 0.43	7.41 ± 0.43	7.37 ± 0.43	7.10 ± 0.49	7.04 ± 0.48	7.15 ± 0.49
Albumin (g/dL)	4.41 ± 0.23	4.41 ± 0.24	4.04 ± 0.23	4.14 ± 0.34	4.10 ± 0.32	4.18 ± 0.35
Total bilirubin (g/dL)	0.64 (0.53, 0.80)	0.70 (0.57, 0.92)	0.60 (0.51, 0.73)	0.49 (0.38, 0.70)	0.55 (0.43, 0.78)	0.45 (0.36, 0.61)
Aspartate aminotransferase (U/L)	26 (23, 30)	27 (23, 32)	25 (22, 29)	26 (22, 31)	27 (24, 32)	25 (21, 29)
Alanine aminotransferase (U/L)	20 (16, 27)	22 (17, 29)	19 (16, 26)	19 (14, 24)	20 (17, 26)	16 (13, 21)
Blood urea nitrogen (mg/dL)	15.3 (12.8, 18.1)	16.0 (13.5, 18.7)	14.8 (12.4, 17.6)	17.9 (14.7, 22.5)	19.3 (15.0, 22.5)	17.9 (14.4, 22.8)
Creatinine (mg/dL)	0.93 (0.84, 1.06)	1.05 (0.96, 1.14)	0.86 (0.81, 0.95)	1.03 (0.90, 1.19)	1.14 (0.99, 1.26)	0.93 (0.87, 1.11)
Glucose (mg/dL)	89 (83, 97)	91 (84, 101)	88 (83, 94)	99 (79, 125)	97 (78, 127)	103 (79, 125)
Insulin (uIU/mL)	6.9 (5.6, 8.9)	6.5 (5.1, 8.4)	7.3 (6.0, 9.3)	15.4 (8.2, 28.7)	15.2 (8.6, 25.1)	15.5 (7.8, 31.7)
Total cholesterol (mg/dL)	183 (160, 209)	173 (151, 194)	192 (169, 214)	165 (144, 197)	161 (140, 185)	176 (148, 203)
HDL cholesterol (mg/dL)	50 (44, 60)	50 (43, 57)	51 (44, 61)	45 (38, 54)	44 (37, 52)	46 (38, 54)
Triglycerides (mg/dL)	139 (104, 87)	135 (99, 185)	141 (105, 189)	132 (97, 190)	114 (92, 177)	134 (102, 197)
C-reactive protein (mg/L)	0.87 (0.50, 1.79)	1.18 (0.64, 2.55)	0.79 (0.45, 1.45)	0.72 (0.36, 1.57)	0.78 (0.37, 2.50)	0.68 (0.35, 1.25)

Data are presented as mean ± standard deviation or median (25th-75th percentiles).
HDL, high-density lipoprotein.

dicular skeletal muscle mass was inversely associated with the augmentation index, an indicator of arterial wall stiffness, even after adjustment for age, BMI, systolic blood pressure, total cholesterol, high-density lipoprotein-cholesterol, fasting glucose, insulin, smoking, and alcohol intake [17].

STRENGTHS AND WEAKNESSES

The most important strength of this cohort is the multidisciplinary assessment of health and its determinants. The baseline examinations include not only a general health questionnaire and physical examination but also an analysis of social network,

blood biomarkers, and some functional tests. A second strength is that this cohort is based within one community and highly representative of this community. Collaboration with the local township offices, public health center, and senior societies as well as the ability to visit homes within the community enabled the high response rate of 94.7% for the KSHAP study and 81.1% for the KSHAP-HE cohort study. Third, we attempted to enroll all respondents' spouses. In total, 235 couples completed both the baseline survey and physical examination. This allows for a future analysis of couple-matched data within this population. Fourth, the KSHAP dataset collected social network data using many identical questions used in the NSHAP in the US for the purpose of international comparison study.

The first weakness of this cohort is a lack of external validation. Although this is a community-based cohort with a high response rate, the study population is only representative of a single community and not of the general Korean population; however, this community is a typical, rural, Korean village. Further studies are required to investigate older Korean adults living outside of rural areas. Second, our sample size is relatively small ($n=698$). We are trying to expand recruitment to neighboring communities to increase the statistical power. Third, a limited numbers of physical examinations and laboratory tests were collected at the public health center or at participants' homes, and no bio-specimens other than serum were stored for future research.

DATA ACCESSIBILITY

Collaborative research is highly encouraged. The KSHAP anonymous dataset is accessible on the Korean Social Science Data Archive's website (<http://www.kosssda.or.kr>). Any interested researchers may have access to the data for academic and teaching purposes without applying for permission. However, for publication purposes, collaboration with a KSHAP investigator is strongly recommended to prevent duplicate publications and inconsistent findings. Researchers interested in collaborative work or requiring further information are invited to contact the KSHAP principal investigator, Yoosik Youm, at yoosik@yonsei.ac.kr or the co-principal investigator for the KSHAP-HE cohort, Hyeon Chang Kim, at hckim@yuhs.ac.

ACKNOWLEDGEMENTS

The Korean Social Life, Health, and Aging Project (KSHAP) is supported by a grant from the National Research Foundation of Korea funded by the Korean Government (NRF-2011-330-B00137).

The authors are grateful to all of the participants and staff for their passion to make this data publicly available.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare for this study.

REFERENCES

1. Lindau ST, Schumm LP, Laumann EO, Levinson W, O'Muirheartaigh CA, Waite LJ. A study of sexuality and health among older adults in the United States. *N Engl J Med* 2007;357:762-774.
2. Cornwell B, Schumm LP, Laumann EO, Graber J. Social Networks in the NSHAP Study: rationale, measurement, and preliminary findings. *J Gerontol B Psychol Sci Soc Sci* 2009 ;64 Suppl 1:i47-i55.
3. Litwin H. The association between social network relationships and depressive symptoms among older Americans: what matters most? *Int Psychogeriatr* 2011;23:930-940.
4. Litwin H, Shiovitz-Ezra S. Social network type and subjective well-being in a national sample of older Americans. *Gerontologist* 2011; 51:379-388.
5. Cornwell EY, Waite LJ. Social network resources and management of hypertension. *J Health Soc Behav* 2012;53:215-231.
6. Shiovitz-Ezra S, Litwin H. Social network type and health-related behaviors: evidence from an American national survey. *Soc Sci Med* 2012;75:901-904.
7. Schafer MH. Discussion networks, physician visits, and non-conventional medicine: probing the relational correlates of health care utilization. *Soc Sci Med* 2013;87:176-184.
8. Husaini BA, Neff JA, Harrington JB, Hughes MD, Stone RH. Depression in rural communities: validating the CES-D scale. *J Community Psychol* 1980;8:20-27.
9. Kim TH, Jhoo JH, Park JH, Kim JL, Ryu SH, Moon SW, et al. Korean version of mini mental status examination for dementia screening and its' short form. *Psychiatry Investig* 2010;7:102-108.
10. Han JW, Kim TH, Jhoo JH, Park JH, Kim JL, Ryu SH, et al. A normative study of the Mini-Mental State Examination for Dementia Screening (MMSE-DS) and Its Short Form (SMMSE-DS) in the Korean elderly. *J Korean Geriatr Psychiatry* 2010;14:27-37 (Korean).
11. Ku BD, Kim SG, Lee JY, Park KH, Shin JH, Kim KK, et al. Clinical practice guideline for dementia by Clinical Research Center for Dementia of South Korea. *J Korean Med Assoc* 2011;54:861-875 (Korean).
12. Gandek B, Ware JE, Aaronson NK, Apolone G, Bjorner JB, Brazier JE, et al. Cross-validation of item selection and scoring for the SF-12 Health Survey in nine countries: results from the IQOLA Project. International Quality of Life Assessment. *J Clin Epidemiol* 1998;51: 1171-1178.
13. Song JS, Park WS, Choi HS, Seo JC, Kwak YH, Kim SA, et al. Pesticide exposure of alpine agricultural workers in Gangwon-do and the measurement of their health status measured by SF-12. *Korean J Pestic Sci* 2005;9:287-291 (Korean).
14. Lee JG, Jin K. The determinants of the quality of life and pain of back pain patients. *J Prev Med Public Health* 2010;43:505-512 (Korean).
15. Burt RS. Network items and the general social survey. *Soc Networks* 1984;6:293-339.
16. Lee WJ, Youm Y, Rhee Y, Park YR, Chu SH, Kim HC. Social network characteristics and body mass index in an elderly Korean population. *J Prev Med Public Health* 2013;46:336-345.
17. Lee SW, Youm Y, Kim CO, Lee WJ, Choi W, Chu SH, et al. Association between skeletal muscle mass and radial augmentation index in an elderly Korean population. *Arch Gerontol Geriatr* 2014. <http://dx.doi.org/10.1016/j.archger.2014.01.008> (in press).